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Human placenta as a dual biomarker for dietary and environmental exposure to mercury in Jamaica and Trinidad and Tobago

Phylicia Ricketts
PhD candidate, UWI

Supervisors: Mitko Voutchkov
Horace Fletcher

Content

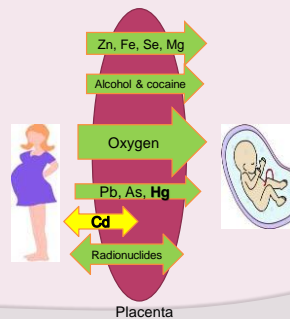
- ◉ Background
- ◉ Research objectives
- ◉ Methodology
- ◉ Results
- ◉ Influence of diet and environment on placenta Hg
- ◉ Recommendations

Effects of prenatal exposure to Hg

- ◉ Low concentrations
 - Delayed walking, language, intelligence
- ◉ High concentrations
 - Microcephaly, cerebral palsy, seizures (Myers, et al 1998)

Biomarker	US EPA Hg reference limit
Maternal Hair	12µg/g
Maternal blood	5.8µg/L
Placenta	???

Placenta as a 'dual' biomarker for Hg exposure

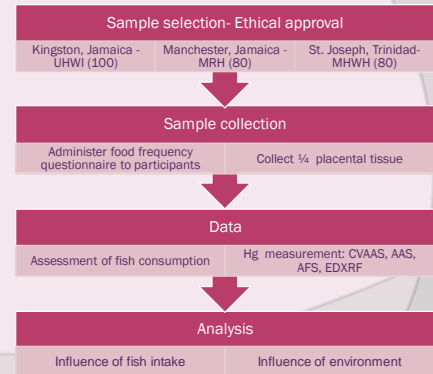


- Used as maternal biomarker (Iyengar, Rapp 2001) (Sakimoto et. al 2013)
- Used as a prenatal Hg biomarker (Bridges, Zalups 2010)
- Influenced by fish intake (Ask et al 2002)
- Influenced by industrial activities (Al Saleh et.al 2011)

Research objectives

1. Is there a difference in placenta **Hg** in different populations?
2. Influence of diet on placenta **Hg**
 - Main source of Hg exposure: fish intake (St. Joseph, Trinidad)
3. Influence of environment on placenta **Hg**
 - Main source of Hg exposure: bauxite mining (Manchester)

Study design



Methodology 1: Sample preparation



Methodology 2: Hg analysis



CVAAS

- Mines & Geology Division
- 400A Hg analyzer
- US EPA Method 245.6 *Determination of mercury in tissue using cold vapour atomic absorption spectrometry*
- DL = 0.4ppb (ww)

Methodology 2: Hg analysis contd.



AAS

- Basu Lab, McGill University
- DMA 80
- US EPA method 7473 *Mercury in solids and solutions by thermal decomposition, amalgamation and atomic absorption spectrophotometry.*
- DL= 6.3ppb dry weight



Methodology 2: Hg analysis contd.

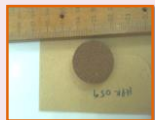


CVAFS

- Basu Lab, McGill University
- TEKRAN 2700
- US EPA method 1630 *Methyl mercury in water by distillation, aqueous ethylation, purge and trap and cold vapour atomic fluorescence spectrometry*
- DL= 2.8ppb meHg (dw)



Methodology 2: Hg analysis contd.



EDXRF

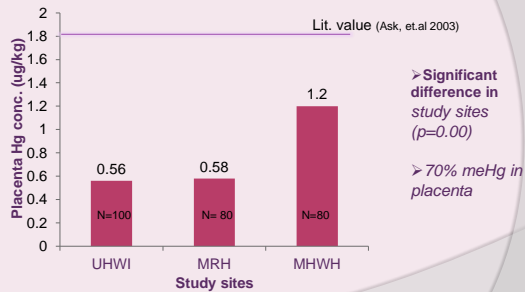
- Radioecology Lab, Dept Physics (UWI-Mona)
- Pelletized 25mm diameter
- Niton XL3T GOLDD
- DL= 2ppm (dw)



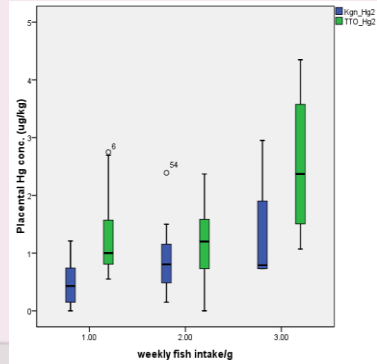
Methodology 3: Questionnaire

Types of fish	Never	Once per 3 months	Once per month	2-3 times per month	Once per week	2-3 times per week	4 or more times per week
1. Shark ()							
1. Saltfish/Cod							
1. Garite							
1. Redfish/ snapper							
1. King Fish							
1. 'Cro cro'							
1. Tuna							
1. 'Cavalli'							
1. Tilapia							
1. Salmon							
1. Grouper							
1. 'Cascadura'							
1. Flying fish							
1. Other ()							
1. Other ()							

Result 1: Mean placenta Hg in Jamaica and Trinidad & Tobago



Result 2: Influence of fish intake on placenta Hg in Jamaica and Trinidad & Tobago

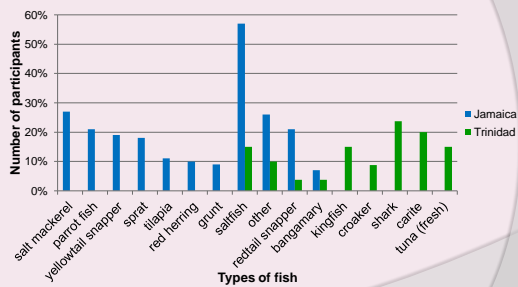


➤ Placenta Hg increased with fish intake

➤ Placenta Hg is higher in Trinidad* with the same fish intake (* $p=0.00$)

Fish intake
1 : <170g
2: 170- 600 g
3: >600g

Types of fish consumed by participants in Jamaica and Trinidad & Tobago



Categories of Fish species found in the Caribbean

Offshore pelagic
(~ 0.35ppm)



'Cavalli'



Kingfish



'Carite'

Large offshore pelagic (~1ppm)



Shark*



Tuna

Reef finfish
(~0.12 ppm)



Snappers

Deep slope
(~0.10ppm)



'Salt fish' / Cod

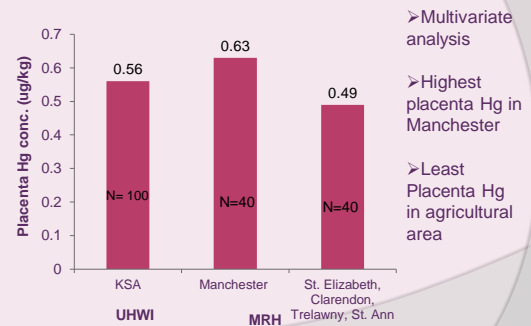
Influence of fish intake on placenta Hg

- Placenta Hg is higher in Trinidad* with the same amount of fish intake(* $p=0.00$)

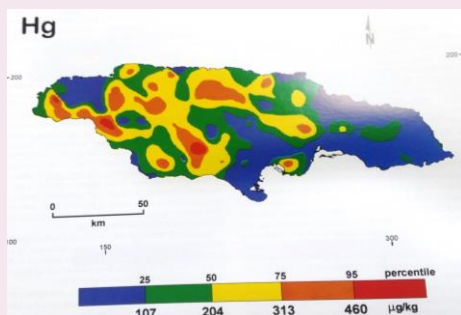
Conclusion

- **Higher Hg exposure from large fish species** (Ricketts, Basu, Fletcher, Voutchkov, Bassaw 2016)
 - Fish consumption between Japanese and Korean communities (Tsuchiya, 2009)
 - Contribution of different fish species to Hg exposure (Groth, 2012)

Result 3: Influence of natural environment on placenta Hg in Jamaica



Soil Hg distribution in Jamaica



*A Geochemical atlas of Jamaica (Lalor et al. 2005)

Influence of natural environment on placenta Hg

- Higher placenta Hg in Manchester
- Lower Placenta Hg in agricultural area

Conclusion

- **Bauxite mining contribute to Hg exposure in Jamaica** (Ricketts, Fletcher, Voutchkov 2015)
 - Soil Hg is highest in central Manchester (Lalor et al. 2005)
 - Anthropogenic sources e.g. industrial activities and urban areas (Nelson et al. 2011) (Al Saleh et al. 2011)

Limitations

	Issue	suggestions
Instrument	40- 50% samples (Jamaica) were below detection limit	Try ICP-MS??
Questionnaire	<ul style="list-style-type: none"> •Dietary recall: Average intake vs. Unusual period •Serving size/ Cooking methods 	<ul style="list-style-type: none"> •Multiple follow ups?? •Bioaccessibility Hg in fish
Hg in fish	Limited database on Hg in Caribbean fish	Measure Hg in Caribbean fish
Prenatal exposure	One biomarker	Additional biomarker cord, fetal blood
Other Hg sources	Cosmetics, occupational exposure	meHg

Recommendations

- ◉ Reduce Hg emission from bauxite mining!
 - Condensers to remove Hg from vapour
- ◉ Fish consumption advisory for safe fish intake
 - Database of Hg in Caribbean fish
 - Monitor frequency and species of consumption

Acknowledgement

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